The Vagueness of Limits and the Desired Distribution of Conducts

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I. INTRODUCTION

Vague rules are much maligned. This article argues that they should be preferred over precise rules because they provide customized compliance. Take the example of the recently liberalized speed limits on highways. Does a state that chooses "reasonable speed" as its limit (such as Montana[1]) provide more or less welfare for its residents than one that adopts a precise limit (such as Florida's 75 mph)? Even if the vague limit is interpreted on average as being equivalent to the precise, it allows those who are in a hurry to drive faster than those who wish to economize gas. Their different choices are the result of their different willingness to suffer a penalty, since the one who is in a hurry may gladly take an even chance at paying a fine if he values timely arrival at more than half the fine.[2] If the policy behind the speed limit is to induce a certain average speed—to increase safety by means of a lower average speed,[3] or for reasons of gas

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1. Notice, however, that Montana's "reasonable speed" limit was, however, struck down as unconstitutionally vague. *See* State v. Stanko, 974 P.2d 1132 (Mont. 1998). Montana now has a speed limit of 75 mph on federal-aid interstate highways outside urbanized areas. *See* MONT. CODE ANN. § 61-8-303 (1999).

2. An example clarifies. Suppose that late arrival to work has the consequence of parking that is more expensive by $20. Travel at 70 mph allows a commuter to arrive on time for the cheaper parking. Half of the time, the route is monitored by troopers who consider speeds exceeding 60 mph to be unreasonable while the other half of the time the route is patrolled by troopers who deem speeds exceeding 70 mph as unreasonable. An unreasonable speed attracts a $30 fine. Given this scenario, a commuter will choose to travel at 70 mph because the expected fine of paying $30 half the time translates to $15 (0.5*$30), which is less than the cost of being late, $20.

3. It is important to note the difference between increasing safety by inducing a lower average speed and increasing safety by means of inducing all drivers to drive at the same speed. A vague limit will achieve the former but not the latter. The precision of speed limits may well be justified by con-

consumption or highway wear and tear—the vague limit is likely to reach the given goal while providing greater total welfare than the precise limit. Effectively, the vague limit allows the slow and the fast driver to unwittingly come to an exchange on how to reach the social goal of maintaining the desired average speed.

By contrast, a precise limit induces uniform conducts at the expense of the customized compliance a vague limit can provide. Consider a car overtaking another on the highway. Compare the difference between the speeds of the two cars under two limits of different precision. Consider first the difference between their speeds under a vague standard of "reasonable speed" that is interpreted on average as a 75 mph limit. Compare that difference in speeds with the difference their speeds would have if a precise "75 mph" rule applied. The two cars' speeds will tend to be closer to one another in the case of the precise limit. Thus, if the goal of the limit is to induce safety by reducing discrepancies in speeds, the precise limit achieves this goal better than the vague limit. Precision induces concentration of conducts, conducts that differ less than they would under a vaguer limit. We shall study here how precise each limit should be, focusing on the effect that choice of precision has on concentration of conducts.

Examples where the choice of precision determines uniformity of conducts abound. The disclosure of financial information of publicly traded corporations follows narrowly defined rules of the Securities and Exchange Commission.[4] The precision of these rules makes corporate communication to the public investors uniform and easier to understand.[5] Other activities, however, are subject to vague standards.[6] The most familiar may be the negligence standard. Negligence law penalizes carelessness by having those who breach a vague limit of "reasonable care" remedy the

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cerns that travel on the same road at very different speeds is hazardous. The existence of minimum speed limits obviously supports this view.

4. Consider, for example, the instructions for S.E.C. Form 1-A, Part II, Offering Circular Model A, Offering and Price Factors, Item 6. The instructions to the issuer are to show the multiple of earnings at which the shares are offered with specifications as to how that calculation must be made, how the number of shares must be adjusted for stock splits and recapitalizations, etc.

5. *See* Michael J. Fishman & Kathleen M. Hagerty, *Disclosure Decisions by Firms and the Competition for Price Efficiency*, 44 J. FIN. 633 (1989); Nicholas L. Georgakopoulos, *Why Should Disclosure Rules Subsidize Informed Traders?*, 16 INT'L REV. L. & ECON. 417 (1996). Both articles recognize that a uniform, standardized method of disclosing financial information, used by all firms, confers a large benefit on investors by allowing them to more easily understand and compare corporations' performance.

6. This Paper will not follow the "rules" versus "standards" distinction popular in academic articles. *See, e.g.*, Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557 (1992). Comparing precise "rules" to vague "standards" misleadingly suggests only two choices of precision or vagueness. This article analyzes vagueness as a question of degree and talks of limits as being more or less vague, whose violation is penalized.

damages their conduct has caused.[7] More apt examples from the vast set of vague rules are veil-piercing and securities fraud liability of issuers. Corporate parents are liable for the debts of their subsidiaries under the veil-piercing doctrine if they fail to maintain a sufficiently separate persona.[8] The variety in conducts under vague rules exceed that observed in conducts governed by precise rules, such as driving speeds and corporate accounting. In other words, under vague rules different potential injurers choose very different levels of care; different parent corporations choose very different patterns of group "separateness;" and different issuers adopt very different policies of corporate disclosure. By contrast, the speed of different drivers does not differ much, and neither does the disclosure form used by different issuers in their SEC filings.

Practically every strain of legal theory has analyzed the issue of vagueness in legal rules. In practice, vagueness seems to dominate to such a degree that it is difficult to find examples of precise rules. Vague standards are common in our legal system and are the focus of classroom discussion in law schools. Consider, for example, the vague boundaries of constitutionally protected speech, the numerous "reasonableness" standards including that of negligence, the very vague corporate veil-piercing doctrine, and the vague "enhanced business judgment rule" of appraising corporate takeover defenses.[9] Practitioners and risk-averse individuals dislike the uncertainty imposed by vague rules. Theory, moreover, supports them because differentiation of conducts can also be obtained by precise rules. Where the law seeks to induce different conducts, a perfect system would

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7. *See* Jason S. Johnston, *Bayesian Fact-Finding and Efficiency: Toward an Economic Theory of Liability Under Uncertainty*, 61 S. CAL. L. REV. 137 (1987) (providing an analysis of negligence in these terms). It is important to note that most work on negligence chooses as its basis the apparently precise Hand Formula. The ("marginal") Hand Formula purports to set a precise limit for carelessness—the point where any further decrease in care increases the expected injury more than it reduces the injurer's costs. But, even to the extent that the Hand Formula is applied, it produces a vague standard of negligence since neither the cost of care nor the expected injury are known with precision. *See* Stephen G. Gilles, *The Invisible Hand Formula*, 80 VA. L. REV. 1015 (1994) (discussing the non-application of the Hand Formula); Mark F. Grady, *A New Positive Economic Theory of Negligence*, 92 YALE L.J. 799 (1983) (critiquing the desirability of the Hand Formula); Thomas J. Miceli, *Cause in Fact, Proximate Cause, and the Hand Rule: Extending Grady's Positive Economic Theory of Negligence*, 16 INT'L REV. L. & ECON. 473 (1996) (critiquing the desirability of the Hand Formula).

8. *See* Robert B. Thompson, *Piercing the Corporate Veil: An Empirical Study*, 76 CORNELL L. REV. 1036 (1991) (describing and providing an empirical analysis of the factors that courts take into account in veil-piercing decisions).

9. The enhanced business judgement rule departs from the business judgement rule, which upholds all corporate decisions of the board of directors that are made with appropriate information and without conflict of interest. The *enhanced* business judgement rule applies to defensive tactics—where a conflict of interests, between managers trying to preserve their jobs and shareholders who desire a takeover premium, is practically inherent—and requires that defensive measures be *proportionate* to the threat posed by the hostile acquiror. *See* Unocal Corp. v. Mesa Petroleum Co., 493 A.2d 946, 949 (Del. 1985) ("On this record we are satisfied that the [defensive] device Unocal adopted is reasonable in relation to the threat posed . . . .").

have a sufficiently complex rule that produces the different mandates. Each different mandate would, therefore, be precise. This claim that vagueness is unnecessary, however, ignores the cost of complexity, which, for the time being, seems to argue in favor of vagueness in a vast number of areas. Moreover, rules are fast becoming so complex that they defy predictability by less than omniscient subjects.

The desirability of vagueness has been examined by many authors in the law and economics tradition. Previous analyses that have dealt with precision frequently assume that precision is desirable, and examine the compromise between the cost of drafting a precise rule at the legislative stage and the cost of applying a vague standard at the judicial stage.[10] Closer to the spirit of this article is the analysis of Craswell and Calfee who argue that vagueness both increases and decreases deterrence, an argument that this paper formalizes.[11] Even they, however, do not discuss differences in conduct because in their model all individuals are identical and make the same choices.

This paper contributes to the discussion of deterrence by exploring the effects of vagueness and by formalizing the regulator's choice of a limit's vagueness. Traditional models of deterrence show that most defendants have incentives to comply exactly with the precise limit.[12] Vague limits have been shown to eliminate this incentive for exact compliance—vague limits deter sometimes more and sometimes less than their precise counterparts.[13] This paper combines, formalizes and expands these results by exploring the effects, and the optimal choice, of vagueness.

But the principal contribution of this article regards the choice of vagueness as a determinant of the distribution of conducts. The desired distribution of conducts, which existing commentary sidesteps, is an integral result of rule-making and must not continue to be ignored.

Although the Enlightenment authors who engaged in analysis of deterrence may have discussed vagueness informally,[14] recent thinking on deter-

10. *See* Isaac Ehrlich & Richard A. Posner, *An Economic Analysis of Legal Rulemaking*, 3 J. LEGAL STUD. 257 (1974); Louis Kaplow, *Rules Versus Standards: An Economic Analysis*, 42 DUKE L.J. 557 (1992); *see also* Colin S. Diver, *The Optimal Precision of Administrative Rules*, 93 YALE L.J. 65 (1983); Anthony I. Ogus, *Quantitative Rules and Judicial Decision Making*, *in* THE ECONOMIC APPROACH TO LAW 210 (Paul Burrows & Cento G. Veljanovski eds., 1981).

11. *See* Richard Craswell & John E. Calfee, *Deterrence and Uncertain Legal Standards*, 2 J.L. ECON. & ORG. 279 (1986).

12. *See, e.g.*, Robert D. Cooter, *Economic Analysis of Punitive Damages*, 56 S. CAL. L. REV. 79, 83-85 (1982); Steven Shavell, *Strict Liability Versus Negligence*, 9 J. LEGAL STUD. 1, 12 n.20 (1980).

13. *See* John E. Calfee & Richard Craswell, *Some Effects of Uncertainty on Compliance with Legal Standards*, 70 VA. L. REV. 965, 976-78 (1984); Cooter, *supra* note 12, at 100-01.

14. *See, e.g.*, CESARE BECCARIA, ON CRIMES AND PUNISHMENTS, AND OTHER WRITINGS 93-94 (Henry Paolucci trans., Bobbs-Merrill Co. 1963).

rence does not focus on vagueness.[15] Those modern works that do focus on vagueness tend to have limited scope, and analyze it primarily in the context of negligence liability,[16] or with regard to other specific regulatory fields, such as environmental law. In all these works, the question of vagueness is approached without regard to the uniformity or correlation of conducts, and optimal conduct often depends on the costs and benefits of each individual separately. This article, however, suggests that the desired correlation (or uniformity) between conducts determines the optimal vagueness of rules. A vague speed limit, for example, will allow drivers to choose different speeds, but will, nevertheless, induce some reduction in the average speed. A precise limit, on the other hand, will induce greater correlation or uniformity of speeds around the limit. In activities where strong correlation is desired, the rules should be precise (as in speeding or financial disclosure). Where correlation is irrelevant, rules ought to be vague (as in negligence or corporate veil-piercing).[17]

Vagueness also appears undesirable if a limit is considered to provide incentives for individuals to follow a socially optimal conduct. However, many limits are clearly only approximations of optimal conduct. Why 65 mph and not 66 or 70 mph? Why 65 parts per million (ppm) pollution instead of 55 ppm? In a negligence context, why "reasonable care"? When limits that lead to optimal conduct cannot be written, we get by with surrogates. Their precision, this article argues, should be set according to the concentration, the uniformity, or the correlation of conducts sought to be induced.

Some commentators have argued that the structure of negligence liability as a limit (as opposed to strict liability) is justified given the uncertain outcome of the litigation process.[18] This article justifies both the uncertainty of negligence liability, as well as the uncertainty of litigation from a different perspective, namely that different injurers need not employ the same care. Society does not have an interest in having all potential injurers apply the same amount of care. Correlation and, therefore, precision are irrelevant from the perspective of social welfare. Vague limits and uncertain trials allow variation among conducts according to individual cost-benefit calculations. Thus, potential injurers can choose different levels of care depending on their own circumstances.

15. Gary S. Becker, *Crime and Punishment: An Economic Approach*, 76 J. POL. ECON. 169, 176-90 (1968); STEVEN SHAVELL, ECONOMIC ANALYSIS OF ACCIDENT LAW (1987); Richard A. Posner, *An Economic Theory of Criminal Law*, 85 COLUM. L. REV. 1193 (1985).

16. *See, e.g.*, SHAVELL, *supra* note 15, Craswell & Calfee, *supra* note 11.

17. The argument that vagueness may be desirable has also been made informally by Gillian Hadfield, who analogizes vague rules with incomplete contracts. *See* Gillian K. Hadfield, *Weighing the Value of Vagueness: An Economic Perspective on Precision in the Law*, 82 CAL. L. REV. 541, 547 (1994).

18. *See, e.g.*, Cooter, *supra* note 12; Jason S. Johnston, *Punitive Liability: A New Paradigm of Efficiency in Tort Law*, 87 COLUM. L. REV. 1385 (1987).

Section II of this article introduces the model of individuals who react to vague limits. As previous commentators have pointed out, vague limits still provide deterrence.[19] Their deterrent effect, however, is felt gradually, which results in individuals no longer exactly complying with the limit. Instead, conducts become more dispersed as vagueness increases.

Sections III and IV of this article refute the superficial conclusion that precision always concentrates conduct. Section III shows that precision cannot overcome bad placement of limits. If a limit is too severe for the tastes of a society, it polarizes conducts, separating those who observe the limit from those who violate it. A vaguer limit at the same location would provide a middle ground and restore continuity in the society's conducts.

Finally, section IV of this article examines expressions of a general dispersing effect that precise limits have: they disperse conducts above the limit. Three expressions of this phenomenon are strikingly frequent: imprecise enforcement, fixed penalties (even fixed fractions of penalties), and trial procedure. They all disperse conducts and increasing vagueness always reduces this polarization.

II. A MODEL OF REACTIONS TO LIMITS

Beginning with an example will facilitate a necessarily complex exposition. Consider a vague speed limit of 65±10 mph and different drivers. Each driver chooses a different speed depending on her preference, i.e., depending on whether she is pressed, whether she is a nature lover, whether she is a spendthrift, accident-prone, etc.[20] Drivers with preferences well in excess of the limit, i.e., those who desire speeds of over 75 mph, will find testing or bucking the limit worthwhile, even though they will be penalized if their conduct is held to be a violation. Some drivers, who prefer a speed of, say, 95 mph or higher, might even consider a certain violation worthwhile. But drivers who would have exceeded the limit only slightly will find the inconvenience of complying with the limit negligible.

A limit is vague by being random and, hence, the specific realizations within its range cannot be known in advance. Moreover, let us suppose that the apprehension of violators and their adjudication are costless and certain, and that no other source of uncertainty exists.[21] Hence, individuals, who choose speeds below the minimum of the limit's range (less than 55 mph in our example of a 65±10 mph limit) are certain that they will not

19. *See* Johnston, *supra* note 18, Craswell & Calfee, *supra* note 11.

20. In this article "preferences" will refer to the level of the activity that would have been chosen if there were no limit, and "conducts" will refer to the levels of activity chosen after the limit is taken into account.

21. Thus, this model is distinguished from models of uncertain apprehension or adjudication. *See, e.g.*, Thomas J. Miceli, *Optimal Prosecution of Defendants Whose Guilt Is Uncertain*, 6 J.L. ECON. & ORG. 189 (1990).

be held in violation of the limit while individuals whose speeds exceed the maximum of the limit's range (over 75 mph in our example) can be sure that they will be penalized (although they do not know the exact limit that will be used to calculate their penalty if the penalty depends on the limit).[22]

Each individual has a unique preferred level of conduct that she would pursue if she were not subject to regulation. Regulation induces individuals to change their behavior toward compliance of limits. However, every equal incremental reduction of conduct becomes increasingly undesirable the further it takes individuals from their respective preferences.[23] Effectively, then those who would have chosen conducts well in excess of the limit find it more onerous complying than those whose preferences are for complying or for only barely violating the limit.

Violations of the limit lead to penalties. Since different levels of conduct lead to different penalties, penalties depend on conduct or, to be more precise, on the severity of the violation, or the degree by which a conduct exceeds the limit. This does not imply, however, a specific relation between the size of the violation and the penalty. Penalties may increase at changing rates as the severity of the violation increases.

Since individuals take penalties into account when choosing their conduct, they face an additional problem if the limit is vague. A vague limit implies uncertainty regarding the location of the limit and, therefore, uncertainty regarding the size of the penalty that a violation would trigger. In determining the most favorable conduct, individuals form an expectation about the penalty that would correspond to each kind of conduct. Although most do this unconsciously, the formal process would be to use each possible realization of the random limit, find the penalty it would imply, and calculate the weighted average of all possible penalties, each weighted by its probability. Thus, if the vague speed limit is 60 mph half the time and 70 mph the other half of the time, and the penalty is $10 for every mile above the limit, a driver going 69 mph has a $45 expected penalty: 50%*9 mph*$10. One who drives at 71 mph has a $60 expected penalty: 50%*11 mph*$10 + 50%*1 mph*$10. Note that if individuals are risk-averse they

22. An intuitive example of such a limit is the limit on carelessness—negligence. The "reasonable man" standard does not give a precise and knowable single-point limit for carelessness beyond which liability will arise and below which liability cannot arise. The negligence limit on carelessness is very much like a random variable, a realization of which will usually be drawn by the jury. Thus, this model is also distinguishable from models of negligence which use a knowable "reasonable man" standard of negligence. *See, e.g.*, WILLIAM M. LANDES & RICHARD A. POSNER, THE ECONOMIC STRUCTURE OF TORT LAW 126-27 (1987).

23. Thus, for example, a driver with a preference for 70 mph suffers little when forced to reduce her speed to 65 mph, but more than that for the equal reduction of speed to 60 mph, and even more for the further, but still equal, reduction to 55 mph. This is a negative statement of the law of diminishing returns, which would have (equal) increases in conduct be less desirable as one approaches one's optimal conduct. In the context of the example, the return from an increase of speed from 55 to 60 mph is great, but the return from the identical 5 mph increase drops when going from 60 to 65 mph, and then it drops further when going from 65 to 70 mph.

will consider the gamble involved in violating the vague limit an additional undesirable feature and will comply a little more.[24] For simplicity, however, we assume individuals are risk-neutral.

To observe the effects of vagueness on deterrence we must compare vague limits with precise limits by keeping the position of the limit identical in both cases. The position of the vague limit is its average position or the mean of its distribution. Thus, if a vague "reasonable speed" limit is interpreted so that speeders are penalized for exceeding, on average, 65 mph, the appropriate precise limit for comparison is one of 65 mph. Such a comparison is made in Figure 1.

The reaction to the precise limit separates three groups of individuals: those to whom the limit is irrelevant; those who choose to comply with the limit, and finally, those who disregard it.[25] For the first group the limit is irrelevant because they have no desire to violate it. Their preference is for a speed of under 65 mph and that is the conduct that they will always choose. The limit, however, becomes relevant starting with those who have a preference for a speed slightly exceeding 65 mph and are deterred by the penalty it produces. Deterrence is produced because a little speed needs to be given up to avoid the penalty. Individuals, who have preferences for speeds exceeding the limit, but are induced to abide by the limit, form the complying group. At some preference for even greater speed, however, the deterrent effect of the penalty fails and individuals with such preferences will choose to violate the limit. These individuals are not deterred because their preferences exceed the limit by so much that they consider the penalty preferable to complying with the limit. Those who deliberately choose to violate the limit form the group that disregards the limit.

Vague limits produce a more complex picture insofar as the complying group must be divided into two sub-groups. Suppose that the vagueness of the limit extends from 55 to 75 mph. The group to which the limit is irrelevant now only encompasses individuals with preferences for a speed up to 55 mph (as opposed to 65 mph in the case of the precise limit). From that point starts the "apprehensive" group of individuals, who adjust their conduct downward (compared to what it would have been under a more

24. *See, e.g.*, Michael K. Block & Joseph Gregory Sidak, *The Cost of Antitrust Deterrence: Why Not Hang a Price Fixer Now and Then?*, 68 GEO. L.J. 1131 (1980); A. Mitchell Polinsky & Steven Shavell, *The Optimal Tradeoff Between the Probability and Magnitude of Fines*, 69 AM. ECON. REV. 880 (1979).

25. Individuals' preferences regarding their conduct will differ and so will their compromises between saving on the penalty and reducing conduct. In order to study individuals' reactions in some orderly fashion, it is necessary to say that all individuals with a given preference follow the same conduct, without allowing individual variation. As simplifications go, this is not radical at all. While each one of the individuals who shares a preference for a specific level of conduct will react differently to a penalty, it is always possible to group them and find their average reaction. Thus, the penalty maps average reactions to preferences. Mapping precise reactions to preferences strips a thin layer of complexity for a large gain in clarity.

precise limit). Effectively, it appears as if they fear committing a violation and trim their speeds accordingly.

Eventually, however, we reach individuals whose speed equals 65 mph, the average of the limit. The preference to which this conduct corresponds is not observable but is crucial. Let us call this preference the limit-inducing preference. This limit-inducing preference separates the complying group into the "apprehensive" group and the "bucking" group. Before exploring this, however, it is worth stepping back and locating the limit-inducing preference in a precise limit. Because in a precise limit the entire complying group follows the same conduct, we cannot identify the one preference that would remain unchanged if the limit became vague. But given that the lower half of the complying group will reduce its conduct (becoming the "apprehensive" group) while the upper half will increase its conduct (to become the "bucking" group), the limit-inducing preference is, in fact, the middle preference of the complying group. Thus, if the precise 65 mph limit is observed by all drivers with preferences from 65 to 75, the limit-inducing preference is 70 mph.

Individuals with preferences higher than the limit-inducing preference will choose speeds exceeding the average of the limit, i.e., greater than 65 mph. Since in a world with the more precise limit these individuals would still have been complying—they would have chosen 65 mph—they appear to be "bucking" the limit, stretching it without committing a certain violation. Their choice is made most obvious by the choices facing the greatest-speed-preferring driver who would still comply with the precise limit (suppose that is the driver who prefers a speed of 75 mph, who under the precise limit would still comply and drive at 65 mph). If this driver had a preference for any higher speed he would violate the limit, i.e., the driver who prefers 76 mph chooses 66 mph under the precise limit. When the limit becomes vague, the old complying conduct will seem too low because an increase in speed no longer leads to a certain violation. Under the vague 65±10 mph limit, a speed of 65 mph is a violation only half the time and a speed of 66 mph is still not very likely to be one. Retaining the previous speed of 65 mph leads to an only 50% chance of a violation, while the driver who prefers 75 mph was ready to accept a certain violation under the precise limit.

The following illustration, produced using a simple model, shows this effect of vagueness by plotting the conduct to which each preference would be led under the two limits.[26] Below the limit-inducing preference, vague-

26. The model posits quadratic utility functions and a linear penalty. Individuals with preferences f choose conduct c and enjoy utility $u(c)=-s(f-c)^2$, where s is a scaling factor. Penalties p() are determined by subtracting the realization of the limit t from conduct c: $p(c)=m(c-t)$, where m is the penalty multiplier. The vagueness of the limit is illustrated by using the triangular distribution. This produces a tent-like triangle instead of the bell curve. Its probability density function is simple: $4(x-min)/(max-min)^2$ from its minimum (min) to its average and $4(max-x)/(max-min)^2$ from there to the maximum

ness increases deterrence (reduces the conduct to which an individual with a given preference is led) and above it, vagueness reduces deterrence (increases conduct).

The Effect of Vagueness: Conducts and Preferences as Vagueness Changes

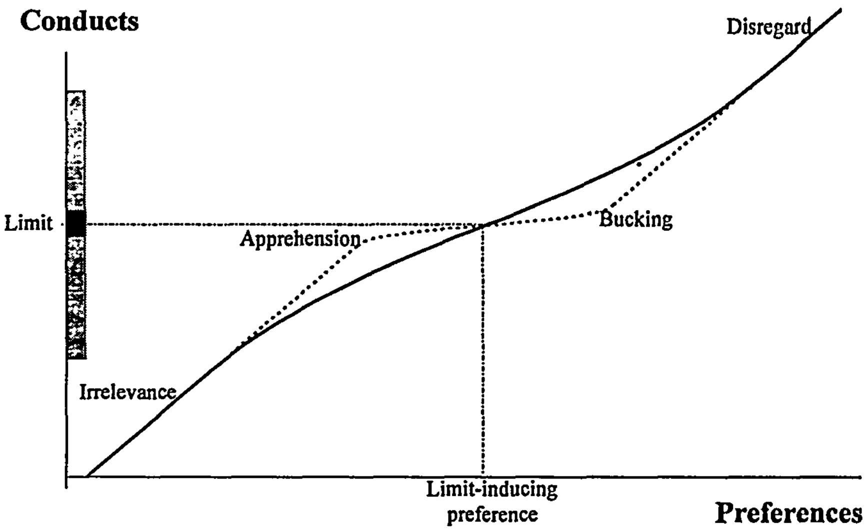

Figure 1: This figure illustrates the differences in the deterrence that a vague limit provides from a precise one. The plots show the conducts (along the y axis) chosen by individuals with different preferences (along the x axis) when they are subject to a vague (solid line) and an almost precise (dashing line) limit. The limits are also marked along the y-axis with the lighter shading corresponding to the range of the vaguer limit and the darker shading corresponding to that of the more precise one. Four areas in the graph deserve note. In the "Apprehension" area, individuals are deterred more by the vague limit. The small probability of violating the limit is enough to induce them to follow lower conducts. In the "Bucking" area, the vagueness of the limit reduces deterrence. Here the limit's vagueness even gives some respite to individuals who would accept a certain violation if they were subject to the precise limit. The limit is irrelevant to the choice of conduct in the "Irrelevance" area, because choosing one's preference will never violate the limit. The choices of those who decide to violate the limit deliberately and with certainty are marked by the "Disregard" area. Here changing vagueness has no effect as long as the precise limit is equal to the average of the vague limit. Individuals are assumed throughout not to be averse to risk.

Thus, the first consequence of vagueness is varied deterrence. A precise

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(max). Its average is the midpoint: (max+min)/2. The optimization problem of individuals is solved for conducts below and above the average and the preferences where they cross the average and where they accept a certain violation are established so that the figure can be produced. A Mathematica® notebook file with this analysis is available from the author or from http://homepages.msn.com/LibraryLawn/Prof_NLG/writing.htm. The symmetry of the figure is due to an additional assumption of the model: that equal reductions of conduct are equally burdensome regardless of each individual's preference.

limit induces both fast and slow drivers to follow the same conduct. Vagueness lets them differentiate their conduct. The fast choose a faster speed and the slow a slower one. This happens while the average speed is mostly maintained. To the extent that a limit has as its goal the imposition of a given average or aggregate conduct, it can be achieved with either a precise or vague limit. The vague limit is superior because it achieves the desired average conduct in a manner similar—although not identical—to a trade between the fast and slow drivers in which those who value speed more buy the right to speed from the others.

A different effect of vagueness, however, is more important from the perspective of social welfare. As vagueness induces the fast to approach their desired speeds while the slow reduce theirs, the overall effect on a society of individuals with various preferences is that vagueness disperses conducts that otherwise would be crowded at the neighborhood of the precise limit. Unlike the variation in deterrence discussed above, the fact that vagueness determines dispersion has the broader consequence that it becomes a tool for the social planner. A planner who determines the desired aggregate or average conduct (such as speed or levels of pollution) can adjust the vagueness of limits to induce the desired dispersion or distribution of conducts.

Therefore, the vagueness of different limits should be determined with regard to the desired dispersion sought to be induced. When concentrated conducts are not a justified goal, a limit need not be precise. Just as the placement of the limit receives attention and requires justification and legitimation, its precision should be treated in the same manner. The need for concentrated conducts must be justified and the imposition of concentration must be legitimated before a precise limit is chosen over a vague one.

III. DISPERSION THROUGH PRECISION

That precision performs a concentrating function in the abstract does not, however, mean that, in fact, precision always induces conducts that are less dispersed than those produced by equivalent vaguer limits. The actual concentrating effect of precision depends on the distribution of preferences in the population as well as on the location of the limit. As this section will show, precision in limits that are too restrictive leads to greater dispersion of conducts than the dispersion to which slightly vaguer limits would lead.

Obviously, some extreme limits may have no effect on the dispersion of conducts. A limit greater than the most extreme conduct desired by any member of society is irrelevant. But under some fairly ordinary constraints, a limit that is so strict that even the individual with the least preference would decide to violate it, will have the same effect: all individuals will change their conduct to mitigate their penalties, but they will change them by the same amount, so that the dispersion of conducts will not change despite the change of conducts.[27] Barring these two extremes, one might think that as a general rule, a limit that lies within the population's preferences would concentrate conduct. Although that is true, the conclusion that a precise limit always concentrates conduct more than a vague one is false. Under some circumstances, vagueness increases concentration.

An austere (strict) precise limit causes a concentration of conducts at the limit, say, 65 mph. Immediately above the limit, say at 66 to 70 mph, there will be some less popular conducts. Further above the limit, say at 75 to 80 mph, lie the conducts chosen by the bulk of the population, who have decided to accept the certain penalty. Thus, an austere precise limit segregates conduct into two clusters, at 65 mph and at 75 to 80 mph. If we plot the frequencies of each conduct, the resulting plot of the distribution has two peaks, one at 65 mph and one at 77.5 mph. By contrast, a vaguer limit that is placed to have the same average position at 65±10mph will have a more gradual effect on conducts, thereby alleviating the polarizing of precision. Unlike the precise limit, which induces drivers who prefer 75 mph to drive at 65 mph, the vaguer limit induces a smaller reduction of conduct on them and pushes higher the cluster of drivers who would have chosen 65 mph to, say, a range of 65 to 75 mph. The following diagram illustrates this effect by plotting the frequency of each conduct in a society with a normal ("bell-curve") distribution of preferences. The figure compares the distribution of conducts according to the precise and the vague rules.

27. Thus, if all drivers' preferences ranged from 50 to 70 mph, a speed limit of 35 mph would have no concentrating effect if even the drivers who prefer 50 mph decide to violate it. They would choose to drive at, say, 40 mph, and the range of conducts will be from 40 to 60 mph. Despite the limit's precision and its reduction of conducts by 10 mph, the overall dispersion of conducts has not changed. Conducts still span 20 mph, from 40 to 60 mph.

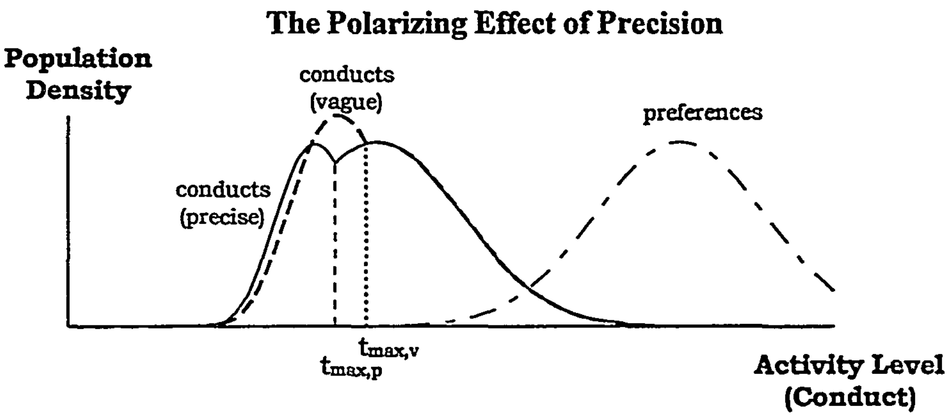

Figure 2: This figure plots the distribution (density) of conducts under an austere and relatively precise limit (solid line) and compares them with the conducts that would be produced by a less precise limit (dashing line). The two limits have the same average (mean) but differ in vagueness. The dashing vertical lines indicate the upper end of the vagueness range for each limit. The preferences of the individuals of this society are normally distributed and both limits' vagueness follows the triangular distribution, which is explained in note 26.

The failure of precision to invariably induce concentration of conducts is crucial because its concentrating effect is thought to be its only concrete virtue.[28] This analysis will now expand by examining features beyond the most general considered above. The framework developed from the previous sections leads to interesting results when it is used to examine specific phenomena of enforcement.

IV. DISPERSING EFFECTS OF CONCENTRATING RULES

That rules may have dispersing effects is in no way unusual, since some rules aim to disperse conducts. That limits may disperse conducts, however, is notable, because the principal function of limits appears to be the concentration of conducts. This discussion will visit three causes of dispersion that may accompany limits: imprecise enforcement, fixed penalties, and procedure.

All three of these dispersing phenomena are local, i.e. only conducts that correspond to some small range of preferences are dispersed. For example, preferences from 80 to 85 mph will be induced to follow conducts from 70 to 78 mph. Moreover, as vagueness mitigates the double-clustering examined above, in all these phenomena, increasing the limit's vagueness reduces dispersion. Because the dispersion as well as the mitigating effect of vagueness have the same cause across all these phenomena,

28. Precision may also provide comfort to risk averse citizens. I have argued that uncertainty is still superior. *See* Nicholas L. Georgakopoulos, *Predictability and Legal Evolution*, 17 INT'L REV. L. & ECON. 475 (1997).

they are worth explaining before we focus on each.

Limits provide incentives to change conduct by creating an expected penalty associated with certain kinds of conduct. The expected penalty reflects how these conducts are penalized on average.[29] It is calculated by multiplying the likelihood of the penalty with the likely size of that penalty. The incentive to reduce some conducts is created because lower conducts imply lower expected penalties, either because the probability of a violation is lower or because the size of the penalty is smaller, or both. Individuals will reduce their expected penalty until a further reduction is not beneficial, i.e. until they would be hurt more from reducing their conduct than they would benefit by reducing the expected penalty. This is the traditional economic concept of equalizing marginal cost and benefit.

This analysis supposes that the deterrence of a penalty does not depend on preferences. It assumes that penalties change at a constant linear rate and that individuals compromise the same way, meaning that equal reductions of conduct from their (different) preferences are equally undesirable.[30] The rate of change of the marginal expected penalty determines whether it will induce concentration or dispersion. An increasingly increasing penalty implies concentration and a decreasingly increasing penalty implies dispersion. If the penalty increases increasingly, those with greater preferences will face larger penalties and be deterred more than those with smaller preferences. Thus, increasingly increasing penalties induce the two groups to follow conducts that differ less than the difference of their preferences. Compare, for example, a driver who prefers 79 mph to one who prefers 99 mph. An increasingly increasing penalty would deter the faster driver more than the slower one. Suppose that the expected penalties are $10 for exceeding 60 mph, $20 for exceeding 70 mph, $40 for exceeding 80 mph, and $60 for exceeding 90 mph. The first 10 mph reduction (from 79 to 69 mph) saves $10 of penalty for the slower driver and the second 10 mph reduction saves him an additional $10. The fast driver,

29. If, for example, the limit is either 55 or 65 mph with equal likelihood, and fines are $10 per mile above the limit, a conduct of 65 mph will attract with equal likelihood either a penalty of $100 or no penalty at all. Thus, this conduct corresponds to an expected penalty of 50%*10mph*$10+0, or $50.

30. This translates to utility functions of identical shapes. The analysis applies, however, not only for penalties that change with increasing or decreasing rates but also as long as the differences of individual utility functions are well behaved, so that, as preferences increase, equal reductions become either consistently more or consistently less undesirable (these effects would correspond to utility functions that become either more or less peaked as preferences increase). Suppose that the expected penalty increases with conduct at a constant rate. Then the deterrent effect would be constant and all violators would reduce their conduct equally if they compromise the same way. If reductions of conduct become more painful as preferences increase, then violators desiring greater conducts would be deterred less. If reductions of conduct become less burdensome as preferences increase, then deterrence would increase with preferences. This distinction will be left to the reader from now on and the Paper will only describe the reactions where all equal compromises are equally undesirable regardless of preference.

however, saves $20 by reducing speed by each of the first two 10 mph reductions.[31] Assume that decreasing speed by the first 10 mph costs $8 to both drivers. Therefore, they are deterred into reducing their speeds by at least 10 mph. If decreasing speed by the second 10 mph costs $15 to both drivers, the slower one would prefer to pay the larger penalty and would not be further deterred. He would, hence, reduce his speed only from 79 to 69 mph. The faster driver will, however, prefer to slow down more.[32] He will make a second 10 mph reduction because doing so saves him $20 at the cost of $15, and he will, therefore, choose to drive at 79 mph. Although the two drivers' preferences differ by 20 mph their conducts are concentrated and differ only by 10 mph.

By contrast, if the penalty were to increase at a decreasing rate, it would imply less deterrence for those with higher preferences, while those with smaller preferences face greater deterrence. Hence, decreasingly increasing penalties induce the two groups to follow conducts that differ more than the difference of their preferences. A limit will have a dispersing effect if its expected penalty increases at a decreasing rate for any range of conducts. Change the penalty of the previous example to a decreasingly increasing one: $10 for exceeding 60 mph, $20 for exceeding 70 mph, $25 for exceeding 80 mph and $30 for exceeding 90 mph. The penalty increases by $10 for breaking 60 and 70 mph, but only by $5 for breaking 80 and 90 mph. The slow driver faces the same deterrence and chooses a reduction of 10 mph. The fast driver, however, will not be deterred at all, because even the first 10 mph reduction of speed saves him less in penalty ($5) than his subjective $8 cost of slowing down. Hence the decreasingly increasing penalty leads to conducts that differ by more (30 mph) than the drivers' preferences, which differ by 20 mph.

The following sections discuss specific expressions of the dispersing effect that decreasingly increasing penalties generally have on the distribution of conducts. Vagueness mitigates this dispersing effect by smoothening expected penalty functions and softening the peaks and valleys of the expected penalty. When the expected penalty changes less abruptly, its rates of change are smaller and the changes of these rates of change are, in turn, reduced. Thus, vagueness slows the decrease of decreasingly increasing penalties. This implies that vagueness reduces the amount by which conducts are led to differ. Instead of the 30 mph difference in the above example, a vaguer limit might induce a smaller difference of 25 mph in the conducts of the two drivers whose preferences differ by 20 mph.

Focusing on actual occurrences of these dynamics will show the prac-

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31. Since 99 mph corresponds to a $60 fine, the reduction to 89 mph, and a $40 fine, saves $20. Slowing to 79 mph, and a $20 fine, saves another $20.

32. To ensure that the fast one will be deterred no more than a total of 20 mph, I make the third incremental 10 mph reduction of speed cost $25 to the drivers.

tical importance of this analysis. Imprecise enforcement (as in the falsely imprisoned in the *Count of Montechristo* and the prosecution of the benevolent by the evil in *The Hunchback of Notre-Dame* and *Robin Hood*), fixed penalties and complex trials (as in *Bleak House*) are what legal thrillers are made of. They are also prime examples of the imperfections of any legal system. What is surprising is that the dispersion of conducts they cause is mitigated by another "imperfection" of the legal system, vagueness.

A. *Imprecise Enforcement*

Imprecise enforcement appears unrelated to vague limits. After all, a limit may be perfectly precise and only its enforcement uncertain. Granted, if the probability of enforcement bears no relation to conduct, penalties for all conducts over the limit will be equally discounted. Under this construct, imprecise enforcement influences the amount of the expected penalty but does not influence whether the penalty increases at an increasing or decreasing rate. Where such an across-the-board uncertainty causes insufficient deterrence, it can be remedied by the conventional "1/p" adjustment: Nominal penalties should be increased to compensate for the uncertainty that they will be imposed.[33]

33. *See* Becker, *supra* note 15; *see also* A. Mitchell Polinsky & Steven Shavell, *Punitive Damages: An Economic Analysis*, 111 HARV. L. REV. 869 (1998) (arguing that jury instructions should include directions on adjusting punitive damages for the probability of detection and prosecution). Once imprecise enforcement takes into account conduct, as discussed in the text immediately below, the 1/p adjustment can be reintroduced to cure that effect. However, if the 1/p adjustment is combined with inaccurate observation of conduct, the result will be a gradually increasing penalty function matching the penalty that is expected under a precisely enforced vague limit. Inaccurate observation is a very likely phenomenon and its fear probably drives the resistance to a purist 1/p adjustment that would impose very large penalties for very slight infractions. *See* Cass R. Sunstein et al., *Do People Want Optimal Deterrence?* (John M. Olin Law & Economics, University of Chicago Working Paper No. 77), *available at* <http://www.law.uchicago.edu/Publications/Working/> (documenting this fear). The inaccurate observation of conduct would influence individuals contemplating conducts immediately below the limit but which conducts are close enough to the limit for some erroneous observations of those conducts to find them violating the limit. Those individuals would be deterred, even though they would not violate the limit. Thus, the 1/p-adjusted penalty starts being felt at conducts below the limit. At some high level of conduct, however, all the possible inaccurate perceptions of it would be violations. Thus, gradually the effect of the 1/p-adjusted penalty with inaccurately observed conduct produces expected penalties identical with those of the nominal expected penalty. When all erroneously observed conducts are violations, then risk-neutral individuals treat the expected 1/p-adjusted penalty with inaccurately observed conducts the same as the 1/p-adjusted penalty with accurate observation of conducts.

Risk-aversion, however, may aggravate the problem of inaccurate perceptions. Risk aversion means that individuals are averse to the probabilistic outcome compared to its certain equivalent: a 10% chance of losing $100 is more undesirable than the certain loss of $10. The 1/p adjustment makes all expected penalties equal to their equivalent nominal penalty under perfect enforcement, but this is a probabilistic calculation which ignores risk-aversion. The lowest probabilities of apprehension, where the 1/p adjustment leads to very large actual penalties, could impress the risk-averse as harsher than the (larger in risk-neutral terms) expected penalties of larger violations. Thus, the 1/p adjustment may not cure the dispersing effect of imprecise enforcement, but may move it from the top of the vagueness

A different effect surfaces, however, if enforcement is imprecise, but is correlated with the defendant's conduct. When large violations are more likely to be detected and penalized, the effect of the uncertainty is not less deterrence across all conducts, but only less deterrence of small violations. This resulting character of the deterrence looks much like that of a vague limit, where small incursions into the vagueness range are unlikely to be penalized, but large ones are almost certain to be held violations.[34] Unlike the paradigmatic vague limit where the penalty depends on the limit's realization—say on the jury which decides as "reasonable" a speed of 61 mph in the case of a vague 65±10 mph limit and, therefore, punishes a 65 mph driver for exceeding the limit by 4 mph—the penalty under imprecise enforcement does not depend on the limit's realization but on the nominal precise limit. If the nominal limit is 55 mph, and a 65 mph driver has a 50% chance of being apprehended, the penalty will always be for a 10 mph violation.

An example of a nominally precise limit would be a speed limit of 60 mph. Imprecise enforcement depending on conduct would imply that drivers speeding at 61 or 62 mph are rarely penalized while drivers racing at 90 or 95 mph are almost always penalized. Unlike under the true vague limit, however, all penalties are calculated on the basis of how much the speed exceeds 60 mph (as opposed to the enforcer's subjective view of what the appropriate limit is). In a precisely enforced but truly vague limit—say, of "reasonable speed"—sometimes the limit will be 60 mph and sometimes not; a speed of 70 mph could sometimes be considered a significant transgression and sometimes a trivial one.

This difference between imprecise enforcement of precise nominal limits and precisely enforced vague limits means that the expected penalty for large (and certain) violations is larger under imprecisely enforced limits than the expected penalty for vague limits but that both increase at the same rate. Since expected penalties under both imprecisely enforced limits and vague limits start together, and the expected penalty of imprecise enforcement ends higher, it increases more rapidly in some range. This happens in the range where apprehension fast approaches certainty. The transition from this fast increase to the slower one of certain apprehension is where imprecise enforcement produces the decreasingly increasing penalties that cause a dispersing effect on conducts.

To see an illustration, let us make the imprecise enforcement of speed limits concrete: The probability of apprehension reaches certainty at 80 mph, i.e., it increases by 5% every mile between 60 mph and 80 mph. The

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range to the bottom. Vagueness, of course, cannot cure this problem, since the $1/p$ adjustment will compensate for changes in vagueness.

34. Compare the example of a 55 mph precise limit, with imprecise enforcement that becomes certain at 75 mph, to a vague limit of 65±10 mph. A speed of 58 mph leads to a small expected penalty under both systems. A speed of 75 mph also leads to a certain penalty under both.

nominal penalty is $10 per mile over the 60 mph limit. The change in the penalty between 80 mph and 81 mph—both violations that lead to certain apprehension—is $10. From 79 mph to 80 mph, however, the penalty increases at a faster rate: The penalty for 79 mph is $180.50 (19 mph * 95% * $10), versus a certain $200 for 80 mph. Thus, the penalty increases decreasingly: It increases by $19.5 from 79 to 80 mph but only by $10 from 80 to 81 mph (21 mph * 100% * $10 - 20 mph * 100% * $10). A driver who would have slowed down from 81 to 80 mph will also slow down to 79 mph. Hence two drivers who under a precisely enforced limit would have chosen 80 and 81 mph will be dispersed by 1 more mile, and will chose 79 and 81 mph, respectively.

Enforcement uncertainty in the real world is, of course, not likely to be as stylized. But it is appropriate to model the uncertainty that results from the cumulative effect of police inattention, paperwork mistakes, funding shortages and all other causes of imprecise enforcement by using the "normal distribution," often called the "bell curve." The unwieldy normal distribution is again approximated to produce Figure 3 by using the easier to handle triangular distribution.[35] Figure 3 shows that while penalties increase at equal rates for small violations (the lower "equal" range in the graph) and at equal rates again for large ones (the higher "equal" range in the graph), the penalties differ, implying that the larger penalty of the imprecise enforcement increases much more rapidly somewhere between these two points where both limits produce equal deterrence. The rate of change of the expected penalty corresponding to imprecise enforcement reaches such great values that it eventually decreases (making the penalty increase decreasingly) to equal that of the paradigmatic vague limit. This can be seen in the lower graph of Figure 3.

The rate of change of the penalty for the imprecisely enforced limit is largest at violations where apprehension starts becoming certain. At that range (marked "accelerate" in Figure 3) violations already facing a large nominal penalty rapidly approach certain enforcement. Once enforcement is certain, the expected penalty becomes the nominal penalty because it does not have to be adjusted for the possibility that it might not be enforced. When enforcement becomes absolutely certain, increases of conduct result in the smaller increases associated with the nominal penalty. Thus, penalties increase decreasingly somewhere in between. This happens in the area of Figure 3 marked "decelerate." Notice that, by contrast, no such phenomenon is associated with the genuine vague limit. The rate of change of the expected penalty gradually increases to match that of a

35. This produces a tent-like triangle instead of the bell curve. Its probability density function is simple: $4(x\text{-min})/(\text{max-min})^2$ from its minimum (min) to its average and $4(\text{max-}x)/(\text{max-min})^2$ from there to the maximum (max). The corresponding cumulative distribution functions are derived by integration and are $2(x\text{-min})^2/(\text{min-max})^2$ and $[(\text{max-min})^2\text{-}2(x\text{-max})^2]/(\text{min-max})^2$, respectively. Its average is the midpoint: (max+min)/2.

certain limit at the average position. Figure 3 again illustrates these comparisons.

Imprecise Enforcement and Vague Limits Compared

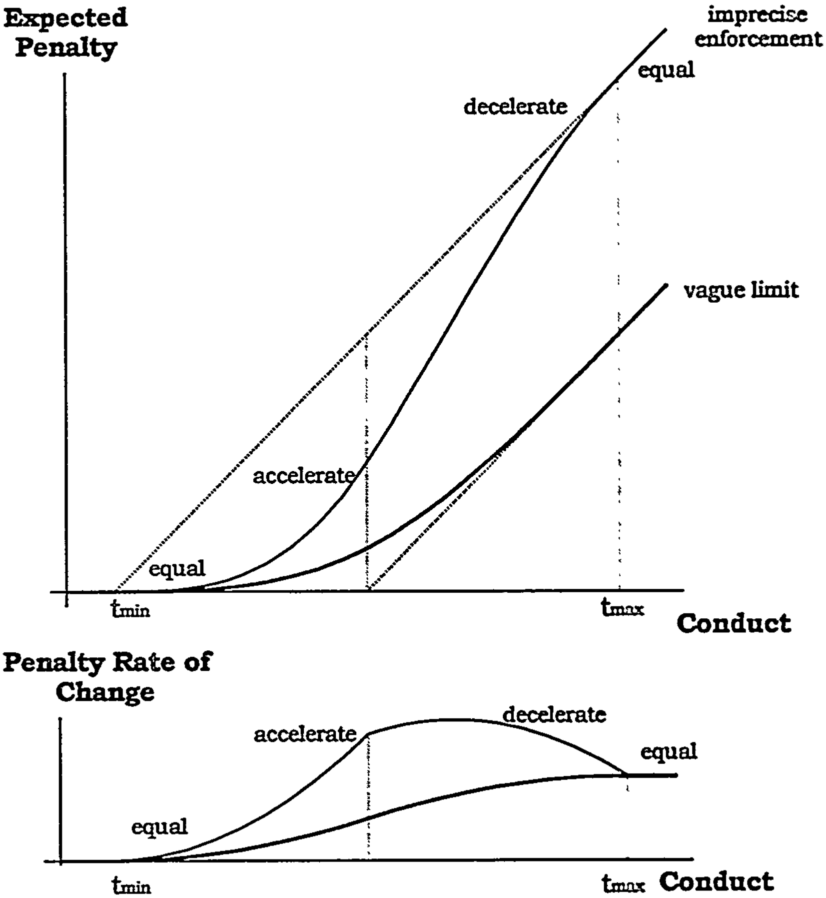

Figure 3: This figure illustrates the difference between the expected penalty produced by imprecise enforcement of a nominally precise limit (such as a 60 mph speed limit) and a precisely enforced vague limit, where the size of the violation depends on the determination of the limit that applies to each violation (such as "unreasonable speed" or "reasonable man" negligence). We see that both penalties start with the same minuscule rate of increase of the penalty (slope) for conducts only slightly exceeding the minimum of the vague limit t_{min} (which is the imprecisely enforced nominal limit). This range is the leftmost area marked "equal" on the graphs. Both expected penalties end up having the same rate of change, equal to the rate of change of the nominal penalty, for conducts exceeding the maximum of the vagueness range t_{max} (which is the maximum of the range of uncertainty for imprecise enforcement). This is the rightmost area of the graphs, marked "equal." But their development differs between these points. The expected penalty of imprecise enforcement increases at an increasing rate (range marked "accelerate") and then increases at a decreasing rate (range marked "decelerate").

Every legal system that has finite resources and depends on inaccurate perceptions and noisy signals, imprecisely enforces its rules, which results in dispersion of conducts. Vagueness mitigates this effect by softening the transitions that a more precise enforcement would cause. Increased uncertainty of enforcement expands the range where the penalty increases at a rate greater than the certain penalty. The expanded range of the large rate of increase allows the rate of increase to be less abrupt and to gradually decrease thereafter.

Increasing the vagueness associated with imprecise enforcement without changing the location of the nominal limit implies reduced deterrence within the vagueness range. Conducts that had some likelihood of apprehension are now less likely to be apprehended. The broadened range of uncertain enforcement also moves the area where conducts are dispersed toward greater preferences. One way to cure the reduced deterrence would be to increase the penalty. Increasing the penalty would, however, aggravate the dispersing effect of imprecise enforcement.[36] A better alternative would be to reduce the limit. The lower limit would increase deterrence, without the increased dispersion that the greater penalties will cause. An example will illustrate.

Consider a society where the preferences for speeds are normally distributed around 70 ±10 mph (the standard deviation). Impose a limit of 55 mph, imprecisely enforced up to 65 mph, where apprehension becomes certain. The probability of apprehension increases slowly at first, rapidly around 60 mph and gradually reaches 100% as 65 mph is reached.[37] We shall compare the distribution of conducts produced by this relatively precisely enforced limit to a lower and more loosely enforced limit: a limit of 45 mph, imprecisely enforced up to 75 mph. Compare the speeds that two drivers are induced to follow according to each rule. Jane Speedy, who prefers a speed of 70 mph, suffers an additional loss of welfare of .16*(70 - her speed) for each mile she slows down.[38] Her best compromise under the more precisely enforced rule is 60 mph.[39] John McFast, who prefers a

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36. Note, however, that the dispersion of conducts, which the greater penalties accentuated after increased vagueness mitigated it, may not be as significant if the greater preferences at which it occurs are sufficiently rare.

37. This follows the triangular distribution, explained above. *See supra* note 35. It differs from the more realistic normal distribution in that it is a finite distribution, producing absolute certainty above its maximum. It does, however, imitate the realism of the normal distribution because changes of probabilities at its extremes are gradual.

38. This is the derivative of her optimization function o(speed)=-.08(70-speed)^2, as defined in note 26. For 1 mile increments, using the center of the increment provides a fair approximation of the change in welfare. For example, we can use 60.5 for the increment from 61 mph to 60 mph.

39. Her tenth mile of slowing down will hurt her about 0.16*9.5=1.52 (I use 9.5 instead of 10 in the derivative to find the change in utility in the transition from the 9th to the 10th mile), while the eleventh mile costs her 0.16*10.5=1.68. Her expected penalty as she slows from 61 to 60 mph will drop by 1.58. At 61 mph her expected penalty is the nominal penalty multiplied by the probability of apprehension, (61-55)G(61)=(61-55)((65-55)^2-2(61-65)^2)/(55-65)^2, where G(x) is the cumulative distribution

speed of 75 mph (with the same pain of .16*[75 - his speed] for deviating from his favorite speed) has his best compromise under the first rule at 69 mph.[40] The vaguer rule induces Speedy to drive again at 60 mph but slows McFast to 65 mph,[41] thereby concentrating their conducts.

The following figure illustrates the effect of these limits on the distribution of conducts. One limit is subject to more imprecise enforcement and is lower than one that is more precisely enforced. Both provide for the same penalty for equal violations. Greater uncertainty makes the distribution of conducts smoother.

The Benefit of Uncertainty in Imprecise Enforcement

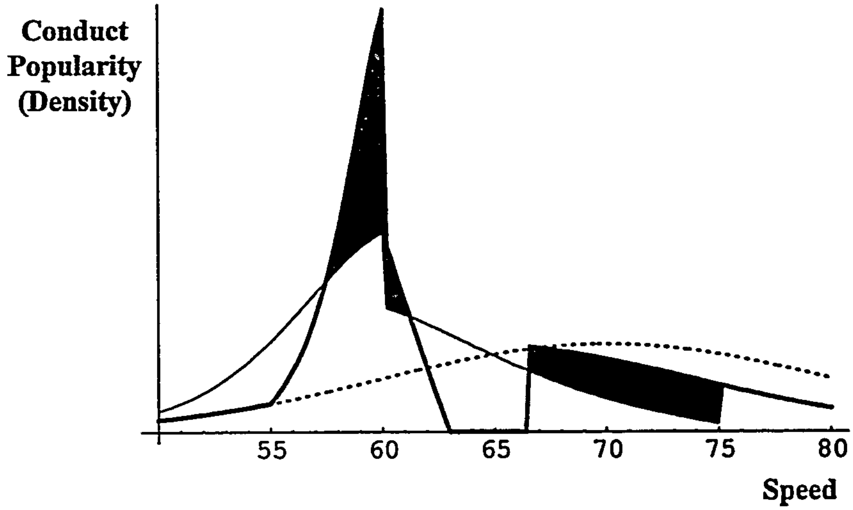

Figure 4: The above figure compares the distributions of conducts subject to two different types of imprecisely enforced limits—the light solid line corresponds to the distribution of conducts under a lower limit having greater uncertainty and the heavy solid line maps the distribution of conducts under the more precise limit—but with the same penalties. As expected, the increased uncertainty results in more gradual adjustments and a smoother distribution of conducts. Roughly speaking,

function of the upper half of the triangular distribution, as explained above. *See supra* note 35. One more mile of slowing to 59 mph, would further reduce the expected penalty by 1.22. She will give 1.52 to save 1.59, but she will not give 1.68 if that only saves her 1.22.

40. The calculation of McFast's cost of reducing speed does not differ from Speedy's. The sixth mile of speed reduction reduces his welfare by 0.88 and the seventh by 1.04. Since he accepts certain enforcement, each mile of speed reduction saves him exactly 1 in penalty. The seventh mile of speed reduction is not cost-justified.

41. They both choose to reduce speed by 10 miles from their optimal speeds, making the outcome identical. The 10th mile of slowing hurts them 1.52 and the 11th hurts by 1.68. McFast saves about 1.66 in expected penalty for both the 10th and the 11th mile, so only the 10th is cost-justified. Speedy saves about 1.53 in expected penalty for the 10th mile. The 11th mile takes her to the lower half of the triangular distribution and the formula of the expected penalty changes to $(\text{speed-limit})G(\text{speed})=(59-45)2(59-45)^2/(45-75)^2$. The resulting reduction in expected penalty for the 11th mile of slowing down (after we subtract the expected penalty for the 11th from that of the 10th) is 1.40. She will suffer 1.52 to save 1.53 of expected penalty, but not 1.68 to save 1.40.

the increased uncertainty brings together the conducts that correspond to the two darkly shaded areas, by means of the increase in popularity of conducts that corresponds to the lightly shaded area that is between them. (The more imprecisely enforced limit is located at 45 mph, and its range of uncertainty ends at 75 mph; the more precisely enforced limit is located at 55 mph, and its range of uncertainty ends at 65 mph. The penalty multiplier (r) for both limits is 1. The scaling factor (a) of optimization functions is 0.08. Preferences are normally distributed with mean 70 and standard deviation 10, marked by the light dotted line.)

In sum, the inescapable phenomenon of imprecise enforcement makes precise limits generate a dispersing effect. Not only vaguer limits, but also increased uncertainty of enforcement, would mitigate this dispersing effect. The next section deals with one more incidence of precision-induced dispersion: rules containing fixed penalties.

B. *Fixed Penalties*

Penalties or parts of penalties that do not depend on the size of the violation are fixed penalties. If violations of every severity receive the same penalty, that results in a pure fixed penalty. Where penalties vary with the size of the violation but contain a residual penalty that burdens even the smallest violation, that part of the penalty is its fixed component.

Fixed penalties, pure or partial, are frequently used in many areas, from minimum and maximum administrative and criminal sanctions, to minimum court fees in civil litigation to the very structure of negligence liability.[42] The effects of fixed penalties are especially important at the upper range of the penalties. When the individual is subject to the maxi-

42. Negligence liability contains as a fixed component the expected injury that would be caused by the most careless conduct that is not negligent. More carelessness increases the expected injury and penalty, but the fixed component remains. Care of $5, say is reasonable, but causes $7 of accidents on average. Those injured by care of $5 do not have negligence claims and the injurer pays no damages. A reduction of care to $4 produces $2 of additional expected injuries, increasing expected injuries to $9. All those injured by care of $4 or less will have negligence claims. The $7 of expected injury that the injurer pays for violating the negligence limit, regardless by how much he violated it, is the fixed component of the negligence penalty.

To formalize, note that the expected injury Ej produced by carelessness t when injury j occurs with probability density g(t) is

$$Ej(t) = \int_{\lambda=0}^{t} g(\lambda) j d\lambda$$

If negligence liability is imposed only where the injurer exhibits carelessness $t>t^*$, then for every $t_1>t^*$ the expected injury which is also the expected penalty is

$$Ej(t_1) = \int_{\lambda=0}^{t_1} g(\lambda) j d\lambda = \int_{\lambda=0}^{t^*} g(\lambda) j d\lambda + \int_{\lambda=t^*}^{t_1} g(\lambda) j d\lambda$$

This is a penalty with a fixed component, namely the first of the two integrals which does not change with conduct.

mum penalty, further violations go undeterred.[43] The literature on bankruptcy and corporate governance is replete with the distortion of the debtor's and the equity-holder's incentives at the point of insolvency.[44] Maximums in criminal and administrative sanctions have the same effect.[45]

Fixed penalties function like sunk costs. Once a conduct is penalized, the part of the penalty that does not depend on conduct no longer has a deterrent effect. This effect is obvious with respect to pure fixed penalties under which, all violations receive the same sanction, and hence, individuals who decide to violate will have no incentive to reduce their conduct or mitigate their penalty. Adding a variable component (as in tacking $10 for each mile over the limit after fixing the penalty for speeding at $50) does not completely remedy this dispersing effect. The deterrence of those who choose to violate the limit is driven by only the variable part of the penalty, while the deterrence of those who decide to comply is driven by both fixed and variable parts.

The dispersion effect of fixed penalties results from the fact that some individuals do feel the deterrent effect of the fixed penalty. Those whose preferences exceed the limit only slightly find the compromise of reducing their conduct to avoid the fixed component of the penalty attractive. The larger the fixed penalty, the greater the range of preferences that feel the penalty's deterrent effect and, therefore, the larger the dispersion of conducts. The last individual who complies with the limit has the greatest deterred preference, while the individual with the preference for the next greater conduct will be undeterred and follow his preference. Their preferences hardly differ but their conducts lie far apart.

The dispersing effect of fixed penalties can be illustrated by returning to the example of Jane Speedy and John McFast. Assume that the precise limit is 55 mph and the penalty, regardless of the size of the violation, is $30. Jane will abide by the limit,[46] while John will not only violate it, but will ignore it and follow the same conduct that he would have if there were

43. Think of the serial killer: he has no incentive to stop after he is already subject to the maximum sentence.

44. Chancellor Allen of the Delaware court of chancery explains how this effect distorts the settlement incentives of the board of directors of a defendant firm that is close to insolvency; he cures the distortion by extending the board's fiduciary obligations to include creditors. *See* Credit Lyonnais Bank Nederland, N.V. v. Pathe Communications Corp., 1991 WL 277613 (Del. Ch. 1991); *see also* RONALD J. GILSON & BERNARD S. BLACK, THE LAW AND FINANCE OF CORPORATE ACQUISITIONS 247-50 (2d ed. 1995) (discussing this phenomenon and providing further citations).

45. While wealth differences ensure that the distortions of (civil) incentives due to insolvency fall at very different points for each individual, administrative and criminal maximums will tend to be similar and, therefore, their effects will be more pronounced.

46. Jane will have to slow down by 15 miles to abide by the limit (from her preference for 70 to 55 mph). Slowing down to 55 reduces her welfare by 18 ($-.08*[70-55]^2$) and this is preferable to the penalty of $30.

no limit.[47] Thus, their conducts have come to differ by 20 mph while their preferences only differ by 5 mph.

Vagueness mitigates this dispersion because the deterrent effect of the fixed penalty is felt gradually. Suppose that a perfectly precise limit is substituted by a vague one having the same average position. The expected penalty inside the vagueness range increases as the fixed penalty becomes more likely to be imposed. Returning to our illustration, let us say that Speedy and McFast face a vague "reasonable speed" limit which is interpreted on average to be 55 ±20 mph and for each mile in the vagueness range the likelihood of violation increases by 2.5%.[48] Facing the same fixed penalty of $30, Speedy will choose 65 mph[49] and McFast 70 mph.[50] Their conducts differ by exactly as much as their preferences. If the goal of the limit is to reduce accidents by harmonizing speeds, the vague limit proves to be more successful.[51] Vagueness effectively converts the fixed penalty into a variable one, albeit only within the vagueness range. Moreover, vagueness closes the gap between the last complying individual and the first violator since conducts at the upper end of the vagueness range are closer to that of the first violator than in the case of the precise limit.

Therefore, unless dispersion of conducts is an acknowledged goal of a rule having fixed penalties, either the fixed penalty must be substituted by a variable one, or the vagueness of the rule must be increased. This partially restores the original distribution of preferences in society, even if conducts have been significantly deterred.

C. *Procedure*

Procedure influences deterrence. It determines the cost and probability with which an enforceable judgment can be produced. In the setting of

47. To abide by the limit, John would have to slow down by 20 miles (from 75to 55 mph), which would reduce his welfare by 32 (-.08*[75-55]^2). This is too large a cost to justify saving the $30 penalty. Once he decides to violate, he returns to his preference for 75 mph.

48. This corresponds to a uniformly distributed limit. Since the penalty is fixed, the actual realization of the limit does not matter. For a driver who chooses to drive at 65 mph, it makes no difference whether the realization of the limit is at 52 mph or 62 mph. There is no need, therefore, to calculate the average position of the limit on the condition that it being below the conduct.

49. To calculate Speedy's optimal speed, consider that she loses 0.16*(70 - speed) of utility for each mile she slows down, as was discussed above. *See supra* note 38 and accompanying text. Thus, her fifth mile of slowing down reduces her utility by 0.16*4.5=.72 (again using the middle of the 5th mile, 4.5, to get its impact). Each mile of slowing down within the vagueness range of 55±20 mph reduces the probability of the conduct being a violation by 2.5%. Given the $30 fixed penalty, this reduces the expected penalty by 75¢. Thus, Speedy's fifth mile of slowing down is cost-justified. The sixth would reduce utility by 0.16*5.5=.88 and not be worth the 75¢ reduction in expected penalty.

50. McFast's fifth and sixth miles of speed reduction reduce his welfare by the same 72¢ and 88¢, respectively that similarly hurt Speedy. Facing the same penalties, he makes the same compromise.

51. The average speed of both drivers under the vague rule is 67.5 mph (65 + 70/2), while average speed under the precise rule is 65 mph. Where the 2.5 miles average speed increase that the vague limit causes should be a problem, its deterrence can be increased by a small increase of the penalty.

civil litigation, distortions of the incentives produced by the flaws of civil procedure have received much attention.[52] Fee-shifting provisions and arbitration are results of concerns about the cost of civil litigation and the potential for nuisance suits. Criminal procedure is somewhat different. The prosecution fights an uphill battle that is designed to avoid penalizing the innocent and to prevent abuse of power. The defense wins by default if guilt is not proven beyond a reasonable doubt. By the same token, a civil plaintiff wins only if she meets the burden of proving her case by a preponderance of the evidence.

Criminal trials are biased in the defendant's favor. The uneven burden of proof is only one of the many of the prosecution's handicaps. A single mistake by the police can make important evidence against the defendant inadmissible as per the "exclusionary rule."[53] In contrast to the defendant's right to raise a series of often repetitive appeals, the prosecution's right to an appeal is much more limited. This type of bias can be analyzed by stylizing it into a single-win-acquits trial for the defendant: any single win by the defendant in any of the prosecution's hurdles and he avoids a guilty verdict. If the defendant faces a trial with several relevant hurdles, the odds of losing the trial are much lower than the odds of losing each hurdle. Four hurdles in which the defendant loses with an 85% probability each make for a 52% probability of conviction ($0.85^4 = 0.52$).[54]

There are generally two distinct types of hurdles that the prosecution must overcome: hurdles that depend on the defendant's conduct and hurdles that present identical odds regardless of the defendant's conduct. A hurdle depends on conduct if the prosecution's odds of surmounting it depend on the severity of the defendant's violation. Because the object of this analysis is to study how procedure influences deterrence, hurdles that do not depend on conduct are irrelevant and can be disregarded.[55]

An explicit hurdle provides a familiar example. In most criminal cases, the prosecution must persuade every juror beyond a reasonable doubt of the defendant's guilt. If, on the lie of the evidence, persuading any one juror is expected with 90% probability, the odds of persuading all

52. *See* Steven Shavell, *Suit, Settlement, and Trial: A Theoretical Analysis Under Alternative Methods for the Allocation of Legal Costs*, 11 J. LEGAL STUD. 55 (1982). For a newer spin on the debate, *see* John J. Donohue III, *Opting for the British Rule, or if Posner and Shavell Can't Remember the Coase Theorem, Who Will?*, 104 HARV. L. REV. 1093 (1991).

53. *See* Barry F. Shanks, Comment, *Comparative Analysis of the Exclusionary Rule and Its Alternatives*, 57 TUL. L. REV. 648 (1983) (surveying the exclusionary rule).

54. Civil trials have a similar bias as will be discussed later. *See infra* note 59 and accompanying text.

55. If conduct-independent hurdles reduce deterrence too much they can be addressed by increasing penalties, akin to the 1/p adjustment. Since the expected penalty for all conducts is reduced by these hurdles, all penalties should increase.

12 are 28% ($.9^{12}$).[56] The structure of criminal trials may hide other hurdle-like features. To the extent that guilt beyond reasonable doubt depends on the clear memory of witnesses and on the pristine state of physical evidence, any defendant who wins an appeal directing a retrial may nearly be out of the woods: time fades memories and adds to the possibility of accidents and mishandling of the physical evidence. Even legal instruction seems geared toward the ability to identify such issues in hypotheticals that, in turn, translates into an ability to raise or anticipate hurdles.

The features of hurdles may vary from trial to trial but the conclusions remain consistent with the one-win-acquits analysis. It is accurate to analyze this hurdle-like feature of criminal trials as a series of random rolls—casts of a die—in which the defendant need only win some, perhaps more than one, of the rolls. Moreover, not all issues in a criminal trial have identical importance. Some types of issues may allow a single win by the defendant to acquit, while other types may only marginally increase the chances of an acquittal. Of course, this analysis applies only to the potentially important issues. Similarly ignored are hurdles that are made irrelevant by their position.[57] There is also no reason to expect that the number of such hurdles is constant in trials. It is likely to be a function of the available time of trial lawyers that in turn translates into a function of the defendant's wealth that can be transferred to lawyers (thus, notoriety may be a substitute for monetary wealth), to the funding of legal aid lawyers, and to other determinants of trial time, as, for example, the trial calendar and docket load.[58]

Suppose, for example, that the prosecution must overcome 12 such hurdles to convict, whether these hurdles are important issues or appeals or jurors. The defendant's conduct influences the odds of losing each of these hurdles (remember that hurdles independent of conduct are irrelevant for

56. This calculation assumes that each juror's beliefs (or the odds in each trial stage or hurdle) are independent of the others'. Although independence may be an excessive assumption, perfect correlation is definitely not the case. If the outcomes of all hurdles were perfectly correlated they would be redundant. By contrast, lawyers' ability to raise several issues even after they have lost one, clearly increases the probability of the defendant's acquittal. The expansion of this model to account for correlation between 0 and 1 among the different hurdles would confuse, rather than illuminate this model and is, therefore, left for the reader to grapple with.

57. Suppose that one hurdle is overcome with certainty when conduct exceeds 29, while others have a range of uncertainty from 30 to 40. The former will not influence conduct because it is dominated by the latter (in the sense that all conducts of 30 result in acquittals). Although this analysis imposes identical location of all hurdles, small variations will not change the conclusions. Large variations will cause some hurdles to be dominated and will effectively reduce the number of relevant hurdles.

58. Other complexities that actual trials would present do not detract from this generalization. If, for example, the last juror tends to be persuaded by the rest, then it would be more appropriate to think of juries with 12 members as having the effect of 11 hurdles. If any win by the prosecution allows the defendant to appeal and increases the possibility of acquittal, the number of hurdles increases. A perfect match is impossible when trying to form a simplified abstraction to analyze a complicated and unpredictable system of events such as a criminal trial.

deterrence). Examples of such conduct may be the form of the crime (heinous crimes may lead to easier convictions) or the defendant's rummaging at the crime scene, which may tend to create more incriminating evidence.

Applying the above analysis to a hypothetical shows the effect of hurdles. Suppose that the defendant avoids guilt if he wins any one of the twelve hurdles and that his conduct (simple crime with and without rummaging or heinous crime with and without rummaging) influences the odds of a guilty verdict in all twelve the same way, from 85% for the simple crime without rummaging to 90% for either the heinous without or the simple crime with rummaging and up to 95% for the heinous with rummaging. Although the likelihood of the penalty increases as the violation becomes greater, this type of uncertainty differs from that in imprecise enforcement. The fact that the prosecution must overcome all hurdles compounds the effect of this uncertainty. Thus, where each hurdle may be overcome by the prosecution with 90% probability, this compounding means that the odds of overcoming all twelve are 28% ($.9^{12}$).

The odds of losing a hurdle-like trial are minimal unless losing each is nearly certain. Raising the per hurdle odds exponentially to the number of hurdles produces credible probabilities of conviction only if the conduct has approached the end of the range of uncertainty, where losing all hurdles becomes certain. From the conduct that reaches certain conviction and on, the expected penalty increases with the slower rate of the nominal penalty. This by now familiar increase of the penalty at a decreasing rate, produces dispersion of conducts. Varying the number of wins required to acquit moves the location of the dispersing effect inside the range of uncertainty with little mitigation of the dispersing effect. The following figure illustrates this by plotting the expected penalties under a 12-hurdles-1-win-acquits scenario and a 12-hurdles-6-wins-acquit one.[59] The difference in the 6-wins-acquit environment, which can be considered akin to the preponderance of the evidence standard, is a rapid rise of the expected penalty at about the mid-point of the range of uncertainty instead of the rise at its upper end that is associated with the one-win-acquits environment.

59. The expected penalty is transformed from the 1-hurdle form it took in imprecise enforcement to the compounded form: $En(t)=M(t)^h n(t, t_{\text{[illegible]}})$, where M(t) in the cumulative density function of the limit, i.e., the probability of losing each hurdle, h is the number of hurdles and $n(t, t_{\text{[illegible]}})$ is the penalty as a function of conduct t and the nominal limit $t_{\text{[illegible]}}$. If the trial were not biased in favor of the defendant, then it might be proper to consider that the plaintiff would have to win only more than half the hurdles (a simple majority, for example, in the jury may be enough) for an acquittal. Then the answer is to model the probability that the defendant will lose half, not all, the hurdles, given by CDF(BIN(h, 1-M(t)), h/2), where h is the number of hurdles, M(t) is the cumulative probability of losing any hurdle given conduct t, and CDF(BIN(.)) is the cumulative distribution function of the binomial distribution. The expected penalty becomes $En(t)=CDF(BIN(h, 1-M(t)), h/2)n(t, t_{\text{[illegible]}})$, but its properties remain very similar to those of the expected penalty of the 1-win-acquits trial.

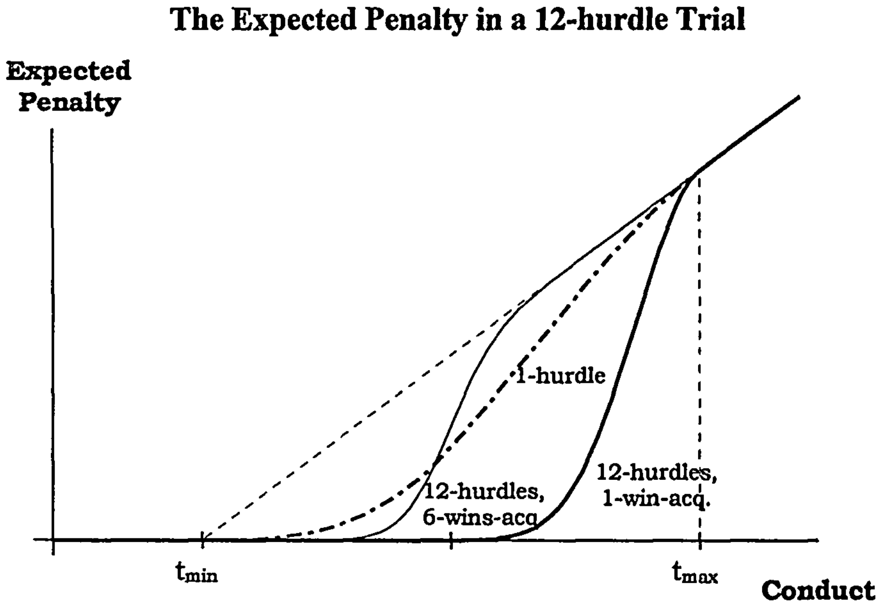

Figure 5: This is an illustration of the effect of hurdles that depend on conduct and which the prosecution (1-win-acquits; heavy solid line) or the civil plaintiff (6-wins-acquit; light solid line) must overcome to reach victory at trial. The expected penalty makes a quick run-up to revert to the nominal penalty at that proportion of the vagueness range which corresponds roughly to the fraction of victories that determine the trial's outcome. (The interesting practical implication is that more procedure only favors the defendant if his conduct in the vagueness range lies beyond the fraction of wins required to convict; compare a conduct two-thirds into the vagueness range under these two trials.) The expected penalty with 1 hurdle is identical to that of imprecise enforcement. The uncertainty follows the triangular distribution, *see supra* note 35, from t_{min} to t_{max} and the penalty multiplier (r) is 1.

Both the degree of uncertainty, as well as the number of hurdles, influence the shape of the expected penalty and its dispersing effect. We shall, next, examine changes in these two dimensions of procedure.

In order to study deterrence as uncertainty changes, we need a constant point around which uncertainty will increase. As in the case of imprecise enforcement, where the limit stays constant, increases in uncertainty would reduce deterrence.[60] As we discovered when comparing limits of different vagueness (where we held the mid-point of the limits constant as we changed vagueness), the fixed point for the comparison of criminal trials of differing uncertainty is the point where the brunt of the deterrence would be felt:[61] the weighted average of the conduct where a

60. That is, if our speeding drivers were to believe that greater violations would lead to the same expected penalty, they would drive faster.

61. We need a point inside the ranges of uncertainty that we can keep constant as we change uncertainty, so that we are able to see how changes of uncertainty pivot around a point that can serve as

guilty verdict is reached.[62] The following figure plots the expected penalty using two different levels of uncertainty. The familiar smoothing of the transitions that more uncertainty causes is apparent.

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the intuitive anchor for the comparison. In the case of the vague limit, the selection of such a point was easy—we just kept the midpoint of the limit constant and varied vagueness around it from, say, a 65±2 mph limit to a 65±10 or ±20 mph limit. Here, we cannot do this because the one-win-acquits trial produces uncertainty that is not conveniently located at the center of the range of uncertainty, but near the end corresponding to more egregious conduct.

62. Formally, that is the weighted average of the resulting distribution of the limit. Calling the probability density function of the limit m(t), the weighted average conviction conduct t_{wa} of the 12-hurdle 1-win-acquits trial will be

$$t_{wa} = \int_{\lambda=0}^{\infty} m(\lambda)^{12} \lambda d\lambda$$

The Penalty and Reaction a hurdle-like Trial Creates: Changing Uncertainty

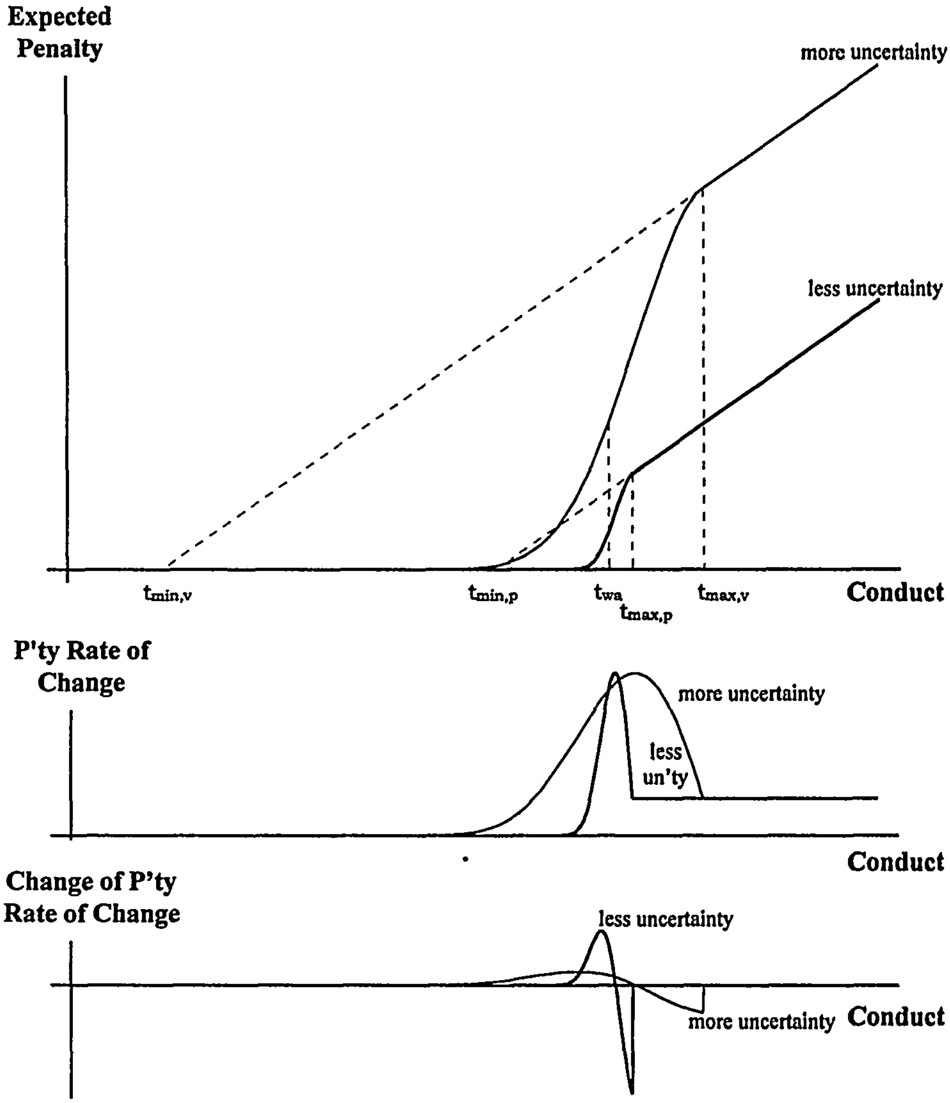

Figure 6: The above figure illustrates the expected penalty (top), the rate of change of the penalty (middle) and how increasingly or decreasingly increasing the penalty is (bottom) under two different ranges of uncertainty in a 12-hurdle 1-win-acquits trial. Notice how the expanded uncertainty translates into smoother transitions. The broad range of uncertainty in the more uncertain trial allows the marginal penalty to decline softly until it reaches the constancy of the certain penalty at $t_{max,v}$. The much narrower range where this change must take place in the case of precision produces a much faster diminishing rate of change of the penalty. Uncertainty follows the triangular distribution, *see supra* note 35, and the penalty multiplier (r) is 1.

The number of hurdles also influences how gradual deterrence is. Reducing the number of hurdles reduces directly the compounding of the odds of guilt. This compounding is accountable for how suddenly the odds of conviction change (from near-nil to certain). Changes in the structure of the criminal trial that would reduce the number of hurdles involve, for example, either a reduction in the number of jurors or a reduction in the procedural means offered to the defendant in challenging the prosecution, such as the elimination of interlocutory appeals. The recent legislation that reduced the number of death-row habeas corpus appeals at the Federal Courts[63] had precisely this effect.[64] Finally, the number of procedural safeguards given to criminal defendants varies not only by jurisdiction and court, but even by judge.

The following figure illustrates the effect that a change in the number of hurdles has on the expected penalty. The greater the number of hurdles that the prosecution must overcome, the steeper the rise of the expected penalty and the less are small infractions of the limit deterred. The sudden increase, however, also implies a rapid reduction of its rate of increase when the penalty reverts to the rate of change of the nominal penalty and, therefore, a strong dispersion of conducts. A reduction in the number of hurdles brings a more gradual increase of the penalty and less dispersion of conducts.

63. *See* Antiterrorism and Effective Death Penalty Act, Pub. L. No. 104-132, 110 Stat. 1214 (amending 28 U.S.C. §§ 2241-2255, and adding 28 U.S.C. §§ 2261-2266 (1994 & Supp. II 1996)).

64. Admittedly, however, the deterrent effect of that particular procedural tool may be dubious. How does the anticipation of a fractional diminution of the odds of execution in favor of life imprisonment influence the deterrent effect of the murder limit? *See, e.g.*, Ehrlich & Zhiqiang Liu, *Sensitivity Analyses of the Deterrence Hypothesis: Let's Keep the Econ in Econometrics*, 42 J.L. & ECON. 455 (1999) (discussing the deterrent effect of the murder limit). *But see* John J. Donohue III & Peter Siegelman, *Allocating Resources Among Prisons and Social Programs in the Battle Against Crime*, 27 J. LEGAL STUD. 1 (1998) (providing a different approach by arguing that education is more cost-justified than harsher penalties).

The Penalty and Reaction a One-win-Acquits Trial Creates: Changing the Number of Hurdles

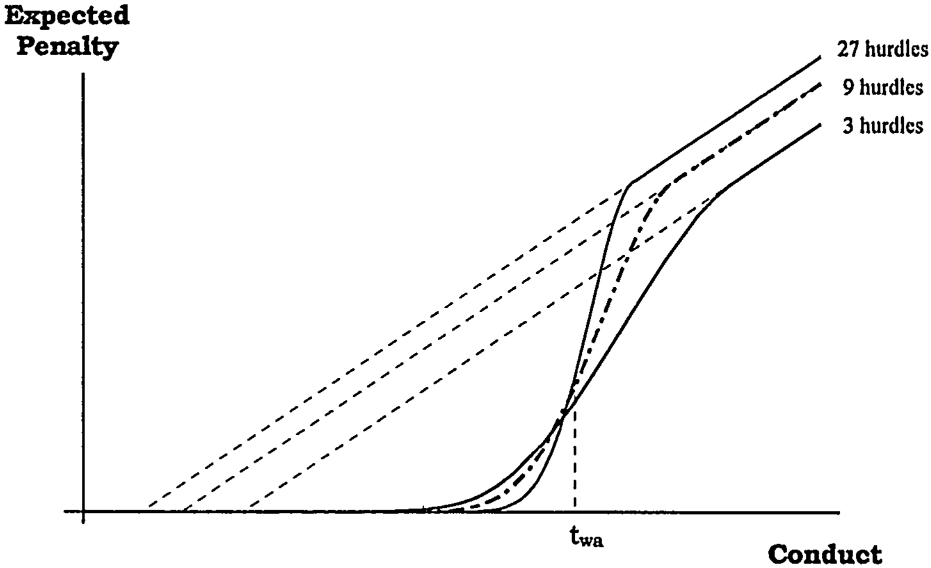

Figure 7: This comparison of trials subject to different numbers of hurdles (with constant uncertainty) shows how more hurdles make the deterrence come later in the range of uncertainty. The more the hurdles, the lower the nominal limit must be for the weighted average conduct of conviction to stay constant at t_{wa}. More hurdles imply larger maximum marginal penalties, faster declines thereafter and more intense dispersing effects. Hurdles range from 3 (heavy line) to 9 (dashing line) to 27 (light line). Uncertainty follows the triangular distribution, *see supra* note 35, and the penalty multiplier (r) is 1.

It should not be surprising that reducing the number of hurdles has an effect similar to increasing uncertainty. Although more hurdles may give the deceptive appearance of greater uncertainty, they create precision. The odds of conviction change from extremely unlikely to practically certain over a narrower range of conducts, which is an attribute of precision.

V. CONCLUSION

That precision leads to dispersion of some conducts should not detract from the more fundamental point: precise limits concentrate conducts; vague limits can restore their original distribution. Precise limits must be justified by having as a goal the concentration of conducts. Limits that only aim to reduce or to increase conducts must be vague.[65] This is as fun-

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65. Limits must be vague, that is, provided that the same goals of desired conducts cannot be achieved by taxes or subsidies. Taxes or subsidies would have general effects on conduct that do not pivot around a limit. Some taxes, of course, are triggered by the breach of a limit, and their effects on conduct should be analyzed as those of limits.

damental a concept as that which holds that rules must be justified by having a goal of influencing conducts. The thoughtless use of precise limits distorts the distributions of conducts with consequences that we cannot estimate or even guess.

Vagueness replaces the abrupt changes in deterrence that precise limits produce by gradually varying incentives to adjust conduct. The goals that precise limits may have in changing levels of conduct can be achieved just as well with vague limits. The customized compliance that vague limits produce also simulates a trade between individuals who desire more of the conduct with those who require less. Moreover, the distribution of conducts that a limit produces is often of paramount importance to the social planner. Vagueness is the variable that determines distributions of conduct.

The analysis of the deterrent effect of precise and imprecise limits can be effectively used to study other expressions of precision in the legal system. Precision often disperses some conducts. In order to make an informed choice about a limit's precision, we must take this dispersing effect into account. When is society better off if some conducts are far apart? Perhaps the dispersing effects of our elaborate trial procedures appropriately separate the violent from the peaceful. If, on the other hand, the segregated violators are unified by social characteristics (gender, race, or sexual orientation, for example) dispersion may hamper their social integration by producing feelings of alienation and deprive society of these marginalized groups' contribution. By lessening procedure, society might embrace these groups before they are led to crime.

Paradoxically almost, the study of uncertainty led to a realization of the conflict between larger penalties and more procedure. Political factions have formed around these objectives. The advocates of "order" seek higher penalties. The advocates of "fairness" promote the preservation of defendants' procedural protections. A political environment that ignores that the two positions produce the opposite effects on deterrence, will naively satisfy both. Penalties will grow and procedural steps will multiply, which seems a fitting description of our criminal system, if not of our entire judicial system. Perhaps we are ready to consider the issue of optimal procedure in conjunction with uncertainty and penalty sizes. Too little procedure presents large chances of errors but smooth distributions of conducts. Too much procedure may polarize conducts and correlate deterrence with wealth—that also translates into lawyer time to add procedural hurdles—and judicial attitudes—because small personal biases, compounded by the numerous hurdles, may result in significantly different expected penalties. The rationing of procedure is not new for the legal system, which uses several different procedural "tracks," from small claims courts to full-fledged federal trials. It is clearly an issue that begs the attention of economic analysis of law.